

It is claimed:

1        1. A phase detector for generating a phase error signal indicative of a phase  
2 difference between a reference signal and an oscillator signal, comprising:  
3        an amplifier to convert said reference signal to a substantially square wave signal;  
4 and  
5        a sampling phase detector to generate said phase error signal from said  
6 substantially square-wave signal and said oscillator signal.

1        2. The phase detector of claim 1, wherein said amplifier comprises a  
2 saturated amplification stage.

1        3. The phase detector of claim 1, wherein said amplifier comprises a first  
2 saturated amplification stage and a second saturated power amplification stage.

1        4. The phase detector of claim 1, further comprising a transformer to convert  
2 a single output of said amplifier to a balanced output.

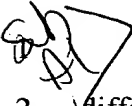
1        5. The phase detector of claim 4, wherein said balanced output have  
2 impedances that substantially match the respective input impedances of said sampling  
3 phase detector.

1        6. The phase detector of claim 1, wherein said amplifier comprises balanced  
2 outputs.

1        7. The phase detector of claim 1, wherein said sampling phase detector  
2 includes a balanced output.

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1           8.       The phase detector of claim 7, wherein said balanced output of said  
2   sampling phase detector are respectively coupled to opposite ends of a potentiometer,  
3   wherein said phase error signal is generated at a wiper contact of said potentiometer.

 9.       A method of generating a phase error signal indicative of a phase  
2   difference between a reference signal and an oscillator signal, comprising:  
3       converting said reference signal to a harmonic-rich signal having a rising and/or  
4   falling edge; and  
5       generating said phase error signal from said harmonic-rich signal and said  
6   oscillator signal.

1           10.      The method of claim 9, wherein said harmonic-rich signal is a  
2   substantially square-wave signal.

1           11.      The method of claim 9, wherein converting said reference signal is  
2   performed by a saturated amplifier.

1           12.      The method of claim 9, wherein converting said reference signal is  
2   performed by a first saturated amplification stage and a second saturated power  
3   amplification stage.

1           13.      The method of claim 9, further comprising converting said harmonic-rich  
2   signal to first and second harmonic-rich signals cycling with substantially opposite  
3   phases.

1           14.     The method of claim 13, wherein said phase error signal is generated from  
2     said first and second harmonic-rich signals.

1           15.     The method of claim 9, wherein generating said phase error signal  
2     comprises:

3           generating first and second phase error signals having substantially opposite  
4     phases; and

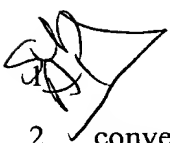
5           adding respective weighted portions of said first and second phase error signals to  
6     generate said phase error signal.

1           16.     The method of claim 15, wherein adding respective weighted portions of  
2     said first and second phase error signals is performed by a potentiometer.

1           ~~17.~~     A local oscillator, comprising:  
2           a reference oscillator for generating a reference signal;  
3           an oscillator for generating an oscillator signal; and  
4           a phase detector for generating a phase error signal indicative of a phase  
5     difference between said reference signal and said oscillator signal, comprising:  
6           an amplifier to convert said reference signal to a substantially square wave signal;  
7     and  
8           a sampling phase detector to generate said phase error signal from said  
9     substantially square-wave signal and said oscillator signal.

1           18.     The local oscillator of claim 17, wherein said amplifier comprises a  
2     saturated amplification stage.

1            19.    The local oscillator of claim 17, wherein said amplifier comprises a first  
2    saturated amplification stage and a second saturated power amplification stage.



1            20.    The local oscillator of claim 17, further comprising a transformer to  
2    convert a single output of said amplifier to a balanced output.

1            21.    The local oscillator of claim 20, wherein said balanced output have  
2    impedances that substantially match the respective input impedances of said sampling  
3    phase detector.

1            22.    The local oscillator of claim 17, wherein said sampling phase detector  
2    includes a balanced output.

1            23.    The local oscillator of claim 22, wherein said balanced output of said  
2    sampling phase detector are respectively coupled to opposite ends of a potentiometer,  
3    wherein said phase error signal is generated at a wiper contact of said potentiometer.

1            24.    The local oscillator of claim 17, wherein said oscillator comprises a  
2    dielectric resonator oscillator (DRO).


1            25.    The local oscillator of claim 17, wherein said reference oscillator  
2    comprises a crystal oscillator.

1            ~~26.~~    A receiver or transmitter having at least one frequency conversion stage,  
2    wherein said frequency conversion stage comprises:  
3            a mixer; and

4 a local oscillator for said mixer, comprising:  
 5 a reference oscillator for generating a reference signal;  
 6 an oscillator for generating an oscillator signal; and  
 7 a phase detector for generating a phase error signal indicative of a phase  
 8 difference between said reference signal and said oscillator signal, comprising:  
 9 an amplifier to convert said reference signal to a substantially square wave  
 10 signal; and  
 11 a sampling phase detector to generate said phase error signal from said  
 12 substantially square-wave signal and said oscillator signal.

1 27. The receiver or transmitter of claim 26, wherein said amplifier comprises a  
 2 saturated amplification stage.

1 28. The receiver or transmitter of claim 26, wherein said amplifier comprises a  
 2 first saturated amplification stage and a second saturated power amplification stage.

1  29. The receiver or transmitter of claim 26, further comprising a transformer  
 2 to convert a single output of said amplifier to a balanced output.

1 30. The receiver or transmitter of claim 29, wherein said balanced output have  
 2 impedances that substantially match the respective input impedances of said sampling  
 3 phase detector.

1 31. The receiver or transmitter of claim 26, wherein said sampling phase  
 2 detector includes a balanced output.

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1           32.    The receiver or transmitter of claim 31, wherein said balanced output of  
2   said sampling phase detector are respectively coupled to opposite ends of a  
3   potentiometer, wherein said phase error signal is generated at a wiper contact of said  
4   potentiometer.

1           33.    The receiver or transmitter of claim 26, wherein said oscillator comprises  
2   a dielectric resonator oscillator (DRO).

1           34.    The receiver or transmitter of claim 26, wherein said reference oscillator  
2   comprises a crystal oscillator.